



# UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office  
Address: COMMISSIONER FOR PATENTS  
P.O. Box 1450  
Alexandria, Virginia 22313-1450  
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/608,152	06/30/2003	Hakansson Bo	ANO 6444 US/SWE 01275	8148
27624	7590	01/11/2011	EXAMINER	
AKZO NOBEL INC.			WILKINS III, HARRY D	
LEGAL & IP				
120 WHITE PLAINS ROAD, SUITE 300			ART UNIT	PAPER NUMBER
TARRYTOWN, NY 10591			1723	
			NOTIFICATION DATE	DELIVERY MODE
			01/11/2011	ELECTRONIC

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

IPANI.PATENT@AKZONOBEL.COM

<b>Office Action Summary</b>	<b>Application No.</b>	<b>Applicant(s)</b>	
	10/608,152	BO ET AL.	
	<b>Examiner</b>	<b>Art Unit</b>	
	Harry D. Wilkins, III	1723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

#### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

1) Responsive to communication(s) filed on 17 December 2010.  
 2a) This action is **FINAL**.                    2b) This action is non-final.  
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

4) Claim(s) 1-3,5-12 and 23-26 is/are pending in the application.  
 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.  
 5) Claim(s) \_\_\_\_\_ is/are allowed.  
 6) Claim(s) 1-3,5-12 and 23-26 is/are rejected.  
 7) Claim(s) \_\_\_\_\_ is/are objected to.  
 8) Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

9) The specification is objected to by the Examiner.  
 10) The drawing(s) filed on 21 November 2003 is/are: a) accepted or b) objected to by the Examiner.  
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).  
 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
 a) All    b) Some \* c) None of:  
 1. Certified copies of the priority documents have been received.  
 2. Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413)
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	Paper No(s)/Mail Date. _____ .
3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)	5) <input type="checkbox"/> Notice of Informal Patent Application
Paper No(s)/Mail Date _____.	6) <input type="checkbox"/> Other: _____ .

## **DETAILED ACTION**

### ***Continued Examination Under 37 CFR 1.114***

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 17 December 2010 has been entered.

### ***Rejection Status***

2. In view of Applicant's amendment to expressly require that the conversion of reactants to chlorate ions continues to occur in the chlorate reactor, all prior rejections are withdrawn. However, in view of a further search new prior art has been discovered to necessitate new grounds of rejection.

### ***Claim Interpretation***

3. The claims require the feature that, after electrolysis, "transferring the electrolysed solution from the anode compartment to a chlorate reactor to react the electrolysed solution further to produce a concentrated alkali metal chlorate electrolyte and where the formation of chlorate continues". Based upon the broadest reasonable interpretation of this claim language, and as supported by the specification (e.g.-see figure 2), the chlorate reactor is essentially any container through which the electrolyte is recirculated to and from the anode compartment.

4. Further, it was known in the prior art that the chemical reaction for the conversion of hypochlorous acid to chlorate ions occurs spontaneously, but at a slow rate. See Czarnetzki et al, page 323, right column, 2<sup>nd</sup> full paragraph to the end of the first paragraph on page 324. Thus, a portion of the hypochlorous acid produced in the anode chamber spontaneously reacts at a later time, due to its slower rate of reaction, to form chlorate ions, no matter where the solution is stored.

***Claim Rejections - 35 USC § 103***

5. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

6. Claims 1-3, 5, 6, 9-12, 23, 24 and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Czarnetzki et al (*Formation of hypochlorite, chlorate and oxygen during NaCl electrolysis from alkaline solutions at an RuO<sub>2</sub>/TiO<sub>2</sub> anode*) in view of Oda et al (US 4,299,682).

Czarnetzki et al teach (see figure 1 and pages 316-317) a process for producing sodium chlorate in an electrolytic cell, the cell being divided by a cation selective separator (M) into an anode compartment and a cathode compartment with anode and cathode, respectively. The process involved introducing an electrolyte solution having a pH of 7 to 12 including sodium chloride into the anode compartment, electrolyzing the solution to produce sodium chlorate (along with sodium hypochlorite and hypochlorous acid) in the anode compartment and transferring the electrolysed solution to a tank (i.e.- a chlorate reactor) to react the electrolysed solution further to produce a concentrated sodium chlorate electrolyte. The formation of chlorate continues in the tank (see pages

323-324 regarding the slow rate of reaction for chemical conversion of hypochlorous acid to chlorate).

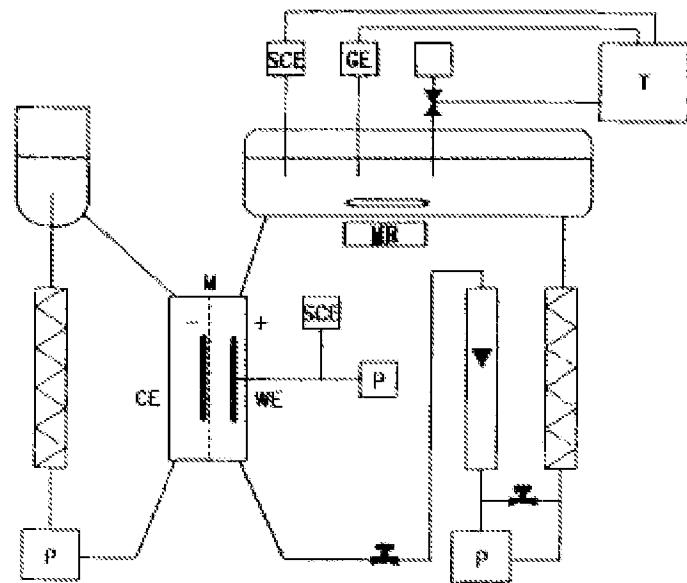


Fig. 1. Experimental set-up. WE: working electrode (anode), CE: counter electrode (cathode), M: membrane, SCE: saturated calomel electrode, GE: glass electrode, T: titrator, MR: magnetic stirrer, P: pump.

Although Czarnetzki et al fail to expressly teach achieving a final chlorate concentration of 650-1200 g/L, based on the disclosure of Czarnetzki et al, one of ordinary skill in the art would have realized that the electrolysis step need only be continued until the chlorate reached its desired concentration since the concentration of chlorate increased with time (see figure 2).

Thus, Czarnetzki et al fail to teach using a gas diffusion cathode in the cathode compartment and the step of feeding oxygen-containing gas into the cathode compartment.

Oda et al teach (see abstract, figure 2, col. 1 and col. 4, line 30-col. 6, line 5) that in divided electrolytic cells for the electrolytic production of  $\text{Cl}_2$  and  $\text{NaOH}$ , the operating voltage of the cell can be reduced by using a gas diffusion cathode, and feeding oxygen to the cathode through a gas chamber (9). The reaction at the cathode involves reaction of the oxygen gas with the water to form hydroxide ions without producing hydrogen gas.

Therefore, it would have been obvious to one of ordinary skill in the art to have used the gas diffusion cathode as taught by Oda et al in the divided electrolysis cell taught by Czarnetzki et al because of the decreased operating voltage which leads to an increased current efficiency.

Regarding claim 2, Oda et al teach (as above, figure 2) that the gas diffusion electrode divided the cathode compartment into a gas chamber (9) on one side of the gas diffusion electrode and an alkali metal hydroxide chamber (7) on the other side thereof. An alkali metal solution was introduced to the alkali metal hydroxide chamber at 12 and an oxygen containing gas was introduced to the gas chamber at 14.

Regarding claim 3, Czarnetzki et al teach (as above) using a cation selective membrane.

Regarding claim 5, the anolyte of Czarnetzki et al contained about 0.25-1.5 kmol/m<sup>3</sup> of sodium chloride, or about 14.6-87.75 g/L.

Regarding claims 6 and 7, Czarnetzki et al teach that the starting concentration of chlorate in the anolyte was able to (see figure 10) decrease operating voltage and decrease the rate of hypochlorite production, but at the cost of increased oxygen

production. It would have been obvious to one of ordinary skill in the art to have selected an optimal amount of sodium chlorate addition (at 106.5 g/mol NaClO<sub>3</sub>) of around either 3-6.5 mol/L (~300-650 g/L) or 0.0001-0.1 mol/L (~0.01-10 g/L).

Regarding claim 9, Czarnetzki et al does not teach any chromates present.

Regarding claims 10 and 24, Czarnetzki et al teach (see page 317) using a catholyte of 1 kmol/m<sup>3</sup> NaOH (~40 g/L).

Regarding claim 11, Czarnetzki et al teach (see page 317) operation of the cell at 25 °C in the catholyte and 70 °C in the anolyte.

Regarding claim 12, Czarnetzki et al teach (see section 5.2.3.) that the chemical conversion to chlorate occurs via reactions (6) and (3a) (see page 316). Both of these reactions produce protons (i.e.-acid), so addition of base (hydroxide) would consume products and drive the reactions toward completion. Therefore, it would have been obvious to one of ordinary skill in the art to have added a portion of hydroxide, produced at the cathode, to the tank to encourage more complete chlorate formation.

Regarding claim 23, the cell of Oda et al included (see figure 2) a gas diffusion electrode (8) which divided the cathode compartment into a gas chamber (9) on one side of the gas diffusion electrode and an alkali metal hydroxide chamber (7) on the other side between the gas diffusion electrode and the cation selective separator. The process of Oda et al included (see Example 1) introducing a weak alkali metal hydroxide solution into the alkali metal hydroxide chamber and oxygen containing gas into the gas chamber. The cation selective separator was a membrane. Czarnetzki et al teach (see page 317) using a pH of the solution of 7-12.

Regarding claim 26, see above regarding claims 1, 5, 6 and 10.

7. Claims 1, 3, 5-7, 9-12 and 24-26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Czarnetzki et al (*Formation of hypochlorite, chlorate and oxygen during NaCl electrolysis from alkaline solutions at an RuO<sub>2</sub>/TiO<sub>2</sub> anode*) in view of Shimamune et al (US 6,117,286).

Czarnetzki et al teach (see figure 1 and pages 316-317) a process for producing sodium chlorate in an electrolytic cell, the cell being divided by a cation selective separator (M) into an anode compartment and a cathode compartment with anode and cathode, respectively. The process involved introducing an electrolyte solution having a pH of 7 to 12 including sodium chloride into the anode compartment, electrolyzing the solution to produce sodium chlorate (along with sodium hypochlorite and hypochlorous acid) in the anode compartment and transferring the electrolysed solution to a tank (i.e.- a chlorate reactor) to react the electrolysed solution further to produce a concentrated sodium chlorate electrolyte. The formation of chlorate continues in the tank (see pages 323-324 regarding the slow rate of reaction for chemical conversion of hypochlorous acid to chlorate).

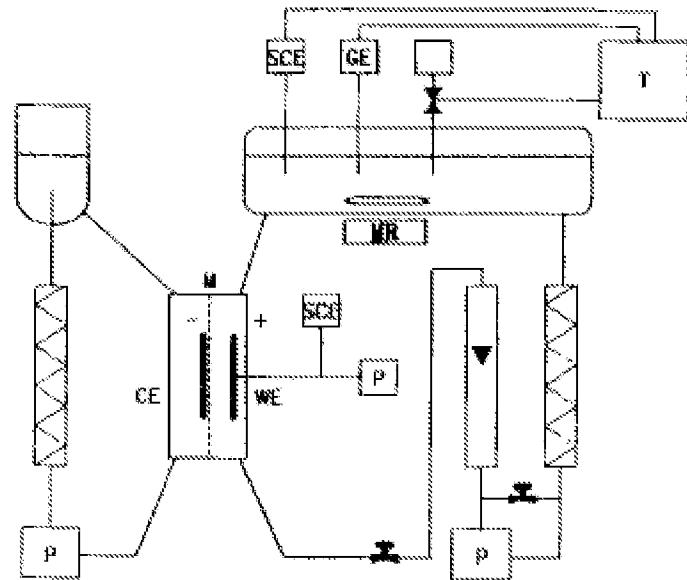


Fig. 1. Experimental set-up. WE: working electrode (anode), CE: counter electrode (cathode), M: membrane, SCE: saturated calomel electrode, GE: glass electrode, T: titrator, MR: magnetic stirrer, P: pump.

Although Czarnetzki et al fail to expressly teach achieving a final chlorate concentration of 650-1200 g/L, based on the disclosure of Czarnetzki et al, one of ordinary skill in the art would have realized that the electrolysis step need only be continued until the chlorate reached its desired concentration since the concentration of chlorate increased with time (see figure 2).

Thus, Czarnetzki et al fail to teach using a gas diffusion cathode in the cathode compartment and the step of feeding oxygen-containing gas into the cathode compartment.

Shimamune teaches (see abstract and cols. 1-3, and particularly col. 2, lines 41-56) that the gas diffusion cathodes are meant to replace hydrogen evolving cathodes (where the cathodic reaction was  $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow 4\text{OH}^- + \text{H}_2$  (-0.83V)) with electrodes that

reacted water with oxygen gas (where the cathodic reaction was  $2\text{H}_2\text{O} + \text{O}_2 + 4\text{e}^- \rightarrow 4\text{OH}^-$  (0.40V)). This means that theoretically the gas diffusion cathode would reduce cell voltage by as much as 1.23 V, with practical reductions of about 0.8 V, resulting in power savings of 700 kWh per ton of sodium hydroxide produced. Thus, one of ordinary skill in the art would have been motivated by the 700 kWh power savings to replace a hydrogen evolving cathode with the oxygen consuming gas diffusion electrode of either Shimamune.

Further, the cell in which the gas diffusion cathode is placed adjacent to the separator/membrane, i.e.-zero-gap, solves many problems associated with either the hydrogen evolving cathode or the three-chamber gas diffusion electrode cells.

Therefore, it would have been obvious to one of ordinary skill in the art to have substituted the gas diffusion cathode of Shimamune et al for the cathode of Czarnetzki et al because Shimamune et al teach that doing so can provide significant cost savings in terms of electricity consumed.

Regarding claim 3, Czarnetzki et al teach (as above) using a cation selective membrane.

Regarding claim 5, the anolyte of Czarnetzki et al contained about 0.25-1.5 kmol/m<sup>3</sup> of sodium chloride, or about 14.6-87.75 g/L.

Regarding claims 6 and 7, Czarnetzki et al teach that the starting concentration of chlorate in the anolyte was able to (see figure 10) decrease operating voltage and decrease the rate of hypochlorite production, but at the cost of increased oxygen production. It would have been obvious to one of ordinary skill in the art to have

selected an optimal amount of sodium chlorate addition (at 106.5 g/mol NaClO<sub>3</sub>) of around either 3-6.5 mol/L (~300-650 g/L) or 0.0001-0.1 mol/L (~0.01-10 g/L).

Regarding claim 9, Czarnetzki et al does not teach any chromates present.

Regarding claims 10 and 24, Czarnetzki et al teach (see page 317) using a catholyte of 1 kmol/m<sup>3</sup> NaOH (~40 g/L).

Regarding claim 11, Czarnetzki et al teach (see page 317) operation of the cell at 25 °C in the catholyte and 70 °C in the anolyte.

Regarding claim 12, Czarnetzki et al teach (see section 5.2.3.) that the chemical conversion to chlorate occurs via reactions (6) and (3a) (see page 316). Both of these reactions produce protons (i.e.-acid), so addition of base (hydroxide) would consume products and drive the reactions toward completion. Therefore, it would have been obvious to one of ordinary skill in the art to have added a portion of hydroxide, produced at the cathode, to the tank to encourage more complete chlorate formation.

Regarding claim 25, Shimamune et al teach (see cols. 2-3) that arranging the gas diffusion cathode adjacent to the membrane permitted several problems with three-chamber gas diffusion electrode cells to be overcome.

Regarding claim 26, see above regarding claims 1, 5, 6 and 10.

8. Claim 8 is rejected under 35 U.S.C. 103(a) as being unpatentable over Czarnetzki et al (*Formation of hypochlorite, chlorate and oxygen during NaCl electrolysis from alkaline solutions at an RuO<sub>2</sub>/TiO<sub>2</sub> anode*) in view of Oda et al (US 4,299,682) OR Shimamune et al (US 6,117,286) as applied above to claim 1, and further in view of Jackson (US 5,294,307).

Czarnetzki et al fail to teach the use of chromate in the anolyte.

However, Jackson teaches (see col. 1, lines 33-41) that addition of chromate ions during the electrolysis of sodium chloride to form sodium chlorate result in significant improvement in cell current efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art to have added chromate ions, as taught by Jackson, to the electrolyte of Czarnetzki et al for the purpose of improving the cell current efficiency, thereby reducing the amount of electricity needed to generate the chlorate.

With respect to the claimed amount of chromate present, Jackson teaches (see the paragraph spanning cols. 13 and 14) using 0.1-20 g/L of total chromium ion.

***Response to Arguments***

9. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Harry D. Wilkins, III whose telephone number is 571-272-1251. The examiner can normally be reached on M-F 9:00am-5:30pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571-272-1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

hdw

/Harry D Wilkins, III/  
Primary Examiner, Art Unit 1795